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(12) # EUROPEAN PATENT APPLICATION

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(54) **A coated substrate and method of making same.**

(57) A process for producing a coated substrate, such as paper, by coating a substrate, preferably in a single step, with a formulation of 50 to 95 parts by dry weight of a solids dispersion of particulate silica and 5 to 50 parts by dry weight binder in water to a coating weight of less than 3.0 g/m^2 per side of the substrate. Also, a substrate, such as paper, coated with a composition of particulate silica and binder in a coating weight of less than 3.0 g/m^2 per side of the substrate.

EP 0 507 998 A1

BACKGROUND OF THE INVENTION

FIELD OF THE INVENTION

The present invention relates to a coating composition that improves the adhesion of imaging materials, such as electrographic toners, inks, etc., to receiving substrates, such as paper. More particularly, the invention relates to a process for producing a substrate coated with the coating composition and the resulting coated substrate.

DESCRIPTION OF THE PRIOR ART

The use of electrographic means to produce a variety of images for different applications is continuing to expand. Examples of the imaging technologies being employed include electrophotography, magnetography, electrostatics, ink jet, thermal transfer, etc. The materials used to generate the visible images can be dry or liquid toners or aqueous-based, solvent-based or hot melt-based inks. The imaging materials may be fused to the substrate by heat, pressure, a combination thereof or by solvation in the case of toners. Fusing by absorption/penetration and by cooling is more typical with jet and thermal transfer inks. There is a need for improved adhesion of these materials to substrates to prevent smudging, smearing and flaking of the image encountered in subsequent handling.

In general, paper is used as the imaging substrate in these systems. It has been found that the degree of fuse quality varies with the grade and source of paper used. Also, it is sometimes desirable to image on substrates other than paper such as labels, plastic films, metal foils or textiles.

Polymeric binders and pigments or particulate silica have been used to form coated substrates for ink jet recording paper and optical bar code printing. Generally, the coatings applied have been in a coating weight of greater than 3 g/m^2 per side of the substrate.

United States Patent No. 4,440,827 to Miyamoto et al. discloses a process for producing a recording paper for ink jet recording and optical bar code printing, the recording paper including a coating layer of an inorganic pigment and an aqueous polymeric binder. The coating is applied by two or more coating steps and includes 100 parts by weight of an inorganic pigment including 50 to 100 parts of synthetic silica and 5 to 18 parts of aqueous polymeric binder.

Miyamoto et al. teaches that it is necessary for the total amount of coating per one side to be 10 g/m^2 or more, preferably 10 to 25 g/m^2. Also, the specification of Miyamoto et al. compares a coating formed in a single coating step to a similar coating formed in smaller repetitive coating steps. Miyamoto et al. found the coatings to be unsatisfactory for use as ink jet recording or optical bar code printing if formed in a single step.

United States Patent No. 4,478,910 to Oshima et al. discloses ink jet recording paper including a base sheet with a coating layer comprising particulate fine silica particles in a water soluble polymeric binder. The sheet is disclosed as providing a superior aptitude for high speed recording with excellent optical density and improved clear image. More specifically, the coating layer comprises fine silica particles having a specific surface are of more than 200 m^2/g, and a water soluble polymeric binder which is preferably polyvinyl alcohol or its derivatives. The preferred ratio of the silica to water soluble polymeric binder is about 60-95:40-5 by solids weight. The preferred coating amount on one side of the substrate is disclosed as between 3-12 g/m^2; however, the actual coating weights exemplified range from 6-12 g/m^2.

United States Patent No. 4,269,891 to Minagawa discloses a recording sheet having a support and an ink absorbing layer thereon. The ink absorbing layer comprises a white pigment and a binder resin, with the weight ratio of pigment to binder ranging from 0.2 to 10. It is disclosed that the ink absorbing power of the ink absorbing layer must be about 1.5 to 18.0 mm/min. Minagawa discloses that a thickness of the coating layer must be at least about 3 micrometers (about 30 g/m^2) to attain the favorable ink absorbing power.

The present invention provides a coated substrate by coating the substrate with a dispersion of particulate silica and a binder to a coating weight of less than 3 g/m^2 per side of the substrate. The coated substrate according to the present invention provides improved adhesion and reduced smudging, smearing and flaking when using a number of varied substrates including paper, plastic films, metal foils and textiles.

SUMMARY OF THE INVENTION

An object of the present invention is to provide a coating composition which provides improved adhesion of imaging materials to substrates to prevent smudging, smearing and flaking of the image.

A further object of the present invention is to provide a coated substrate that has improved fuse

deterioration, improved pencil receptivity and a lower coefficient of friction.

The above-described objects are attained by coating a substrate with a coating composition comprising 50-95% by dry weight of particulate silica and 5-50% by weight binder to a coating weight of less than 3.0 grams per square meter per side of the substrate.

DETAILED DESCRIPTION OF THE INVENTION

The present invention relates to a coating composition that improves the adhesion of imaging materials, such as electrographic toners, inks, etc., to receiving substrates, such as paper. The coating composition of the invention is obtained from a coating formulation comprising a particulate silica, water and a polymeric binder such as polyvinyl alcohol, carboxymethyl cellulose, cellulosic ethers, starch and its derivatives, gelatin, albumin, gum arabic alginates, polyacrylamide or polyvinylpyrrolidone, or mixtures thereof. As used herein, coating formulation refers to the mixture that is initially applied to the substrate, while coating composition refers to the coating after application and drying. The coating formulation comprises 50 to 95 parts by dry weight of particulate silica and 5 to 50 parts by dry weight binder in water. The water content may vary widely while maintaining the silica and binder contents within the above ratio. A preferred coating formulation comprises about 25-45% of a 20% solids dispersion of particulate silica, more preferably 36% in water, about 5-50% of a 10% solution of partially hydrolyzed polyvinyl alcohol, more preferably 28%, and about 25-45% water, more preferably 36%.

The resulting coating composition may vary from 50 parts to 95 parts silica by dry weight and from 5 parts to 50 parts by weight binder. Additional water or some other polar solvent may be added to adjust viscosity to that most suitable for the coating process used. Suitable polar solvents include alcohols such as isopropanol, ethanol, butanol and mixtures thereof. Other additives may be included, for example, biocides such as Nalco 1620 WB (Nalco Chemical Co.), defoamers such as Nalco 2308 (Nalco Chemical Co.), slip agents such as zinc stearate, calcium stereate and stearamide or anti-offset compounds such as wheat starch, pea starch and cellulose fibers.

The coating composition according to the present invention is useful in the following imaging technologies: electrophotography, magnetography, electrostatics, ink jet and thermal transfer. The coating composition provides improved adhesion to substrates to prevent smudging, smearing and flaking of the image. The coating composition may be applied to any of the commonly known substrates such as paper, labels, plastic films, metal foils or textiles. Specific applications include financial documents or titles which require a very high degree of security to prevent image alteration, and also documents which require resistance to subsequent handling to prevent rub, smear, flaking, crease, erasure, tape pick, and scratch.

In accordance with the invention, the coating formulation may be applied by conventional techniques such as flexo, gravure, reverse roll, air-knife, etc. It may be full-coated or spot coated. Drying of the coating may be effected by conventional means such as hot air convection, microwave or infrared. When using coated paper of the invention in a laser printer, it is desirable that the moisture content of the paper range from 4.2-5%, to avoid the paper being too conductive (water content too high) or a buildup of static electricity (water content too low).

The coating formulation of the invention is applied to a coat weight of less than 3.0 grams per square meter per side of substrate, preferably between 0.4 and 2.8 g/m^2 per side of the substrate. The coating weight is preferably applied in a single coating step. It has been found by the inventors that, at coating weights greater than 3.0 g/m^2, fuse (toner adherence when subjected to folding and scratching) deteriorates, pencil receptivity is poor, and the coefficient of friction increases making feeding to printers and stackers more difficult.

Particulate silicas for use in the invention include CaboSperse A-105, CaboSperse P-1175, CaboSperse S-109, CaboSperse P-1010, Aerosil 130, Aerosil 200 and Aerosil MOX80. CaboSperse S-109 is preferred. A particulate silica is preferably utilized that has a uniformity number n for the Rosin-Rammler distribution ranging from 1.0-2.6.

A preferred particulate silica useful in the present invention, CaboSperse S-109, has a specific surface area ranging from 90-270 m^2/g as measured by the BET method and a uniformity number for the Rosin-Rammler distribution of about 1.22. The base sheet to which the coating composition is applied is not limited but generally will have a Stockigt sizing degree of greater than 7.

The present invention will be described more completely with reference to the following examples, which in no case may be regarded as limiting the invention.

Example 1

A coating formulation as follows:

CaboSperse (silica)	35.95%
10% Vinol 540 (binder)	28.10%
Water	35.95%

was full-coated on both sides of 24# OCR bond on a flexo coater to a coat weight of 1.1 g/m^2/side and a moisture content of 5%. The roll was converted to both continuous and cut sheet product, preprinted with heat set inks and tested along with the uncoated base sheet on the following copiers and printers:

Xerox 1090, Xerox 5052, Xerox 9700 (all dry toner hot roll fusers);
STC 6100 (dry toner, cold vapor fusing); and
Ion Deposition (dry toner, cold pressure fusing).

Fuse quality was rated in the areas of crease resistance, tape pick up and scratch. In every case, fuse quality of the coated sheet was superior to that of the uncoated sheet. See Table 1, below.

Example 2

The method according to Example 1 was repeated except that the coating formulation was applied as a 1" by 5" spot with a 110 anilox roll on a conventional flexo press on 24# OCR bond and then dried with an RF dryer.

The results obtained are set forth in Table 1, below.

Example 3

The method of Example 2 was repeated except the formulation was coated onto the face of a label stock having a 60# OCR facestock and 50# release liner.

The results obtained are set forth in Table 1, below.

Example 4

The method of Example 2 was repeated except the formulation was coated onto the back of the release liner of a label having a 60# OCR facestock and 50# release liner.

The results obtained are set forth in Table 1, below.

Test Method for Measuring the Toner Anchorage/Adhesion

To evaluate the toner anchorage properties the following procedure was used.

Tape Pick-Up

A 4" strip of Magic tape (3M brand scotch tape) was applied to the printed area to be tested using light finger pressure. Medium finger pressure was then applied back and forth over the taped area for a total of 10 passes. The end was grasped and the tape was slowly peeled from the printed area.

Magic tape was lightly applied to another test area and carefully removed and placed on the record sheet.

Scratch

Printed areas were scratched with a stainless steel spatula using a back and forth motion and medium pressure. The printed areas were scratched for a period of 10 passes.

Crease

The substrate was folded inward and creased in the printed area. The substrate was unfolded and scratched in the folded area using light pressure.

Calculations

The printed product toner anchorage/adhesion was rated on a scale from 1 to 6, 1 being the best. The evaluation was subjective and depended upon the before and after testing appearance of the image.

The breakdown of the scale is as follows:

1 - No toner loss
2 - Slight toner loss detected only on tape-product good
3 - Visible toner loss from image-product marginal
4 - Moderate toner loss from image-product below standard
5 - Heavy toner loss, flaking or image damage-product failure
6 - No toner adherence to the substrate-product failure far beyond that rated as 5

Table 1

Equipment	Image Material	Fuse Method	Substrate	Adhesion Crease	Tape	Scratch
Xerox 1090	2-C toner	hot roll	24# Bond	4	3	4
			Exp. 1	1	1	1
			Exp. 2	1	1	1
			uncoated FS	5	4	4
			uncoatedRel	6	6	6
			Exp. 3	1	1	2
			Exp. 4	1	1	3
Xerox 5052	2-C toner	hot roll	24# Bond	3	3	4
			Exp. 1	1	1	1
			Exp. 2	1	1	1
			uncoated FS	5	4	4
			uncoatedRel	6	6	6
			Exp. 3	1	1	2
			Exp. 4	1	2	3
Xerox 9700	2-C toner	hot roll	24# Bond	3	3	4
			Exp. 1	1	1	1
STC 6100	2-C toner	vapor	24# Bond	2	3	3
			Exp. 1	1	1	1
IBM 3836	2-C toner	hot roll	24# Bond	5	4	5
			Exp. 1	1	1	1
Delphax 2460	MC toner	pressure	24# Bond	4	5	5
			Exp. 1	2	1	2

uncoated FS = Uncoated facestock (control)
uncoatedRel = Uncoated release (control)

Claims

1. A process for the production of a coated substrate comprising;
coating a substrate with a formulation of 50 to 95 parts by dry weight of a solids dispersion of particulate silica and 5 to 50 parts by dry weight binder in water, to a total coating weight of less than 3.0 g/m^2 per side of the substrate.

2. The process according to claim 1, further comprising drying the coated substrate preferably by air convection, microwave or infrared.

3. The process according to claim 1 or claim 2, wherein the coating is carried out in a single step.

4. The process according any of claims 1 to 3, wherein the formulation further comprises an additional amount of a polar solvent.

5. The process according to claim 4, wherein the polar solvent is selected from isopropyl alcohol, ethanol, butanol and mixtures thereof.

6. The process according to any of claims 1 to 5, wherein the coating weight is between 0.4 and 2.8 g/m^2 preferably about 1.1 g/m^2, per side of the substrate.

7. The process according to any of claims 1 to 6, wherein the formulation further contains at least one of a biocide, a defoamer, a slip agent or an anti-offset compound.

8. The process according to any of claims 1 to 7, wherein the coating formulation is applied by a technique selected from flexo, gravure, reverse roll and air-knife.

9. The process according to any of claims 1 to 8, wherein the particulate silica has a specific surface area ranging from 90-270 g/m^2

10. The process according to any of claims 1 to 9, wherein the formulation comprises about 25-45% of a 20% solids dispersion of particulate silica in water, about 5-50% of a 10% solution of partially hydrolyzed polyvinyl alcohol, and about 25-45% water.

11. The process according to claim 10, wherein the formulation comprises about 36% of a 20% solids dispersion of particulate silica in water, about 28% of a 10% solution of partially hydrolyzed polyvinyl alcohol, and about 36% water.

12. The process according to any of claims 1 to 11, wherein the binder is selected from polyvinyl alcohol, carboxymethyl cellulose, cellulosic ethers, starch and its derivatives, gelatin, albumin, gum arabic alginate, polyacylamide and polyvinylpyrrolidone.

13. A coated substrate comprising;
a substrate having coated thereon a composition of 50 to 95 parts by dry weight of a particulate silica and 5 to 50 parts by dry weight of a binder in a coating weight of less than 3.0 g/m^2 per side of the substrate.

14. The coated substrate according to claim 13, wherein the substrate is toner paper.

15. The coated substrate according to claim 13, wherein the substrate is selected from paper, labels, plastic films, metal foils and textiles.

16. The coated substrate according to claim 14 or claim 15, wherein the coated substrate is paper having a Stockigt sizing degree of greater than 7.

17. A coated substrate according to any of claims 13 to 16 made by the method of any of claims 1 to 12.

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EUROPEAN SEARCH REPORT

Application Number

EP 91 12 1570

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)
X	DATABASE WPI, nØ 77-40795y, Derwent Publications Ltd, London, GB; & JP-A-52053012(JUJO PAPER) *The entire abstract* ---	1,3,6, 10-15,17	D21H19/60 D21H19/40
X	ABSTRACT BULLETIN OF THE INSTITUTE OF PAPER CHEMISTRY, vol 57, nØ 3, September 1986 page 460, abstract nØ4073, Appleton, Wisconsin, US; & JP-A-60204390(MITSUBISHI PAPER MILLS) -----	1,3,6, 10-15,17	

TECHNICAL FIELDS SEARCHED (Int. Cl.5)

D21H
B41M

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	28 JULY 1992	FOUQUIER J.

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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